Physics 4A Quiz 3 February 24, 2006
Professor C. M. Surko

Potentially useful information:

$g = 9.8\ m/s^2$

$\vec{A} \cdot \vec{B} = A_x B_x + A_y B_y + A_z B_z$

If acceleration a_x is constant, then:

$$v_x = v_{xo} + a_x t$$

$$x = x_o + v_{xo} t + \frac{1}{2} a_x t^2$$

$$v_x^2 = v_{xo}^2 + 2a_x (x - x_o)$$

If a_y is a function of time, a(t), then:

$$v_y(t) = v_{yo} + \int_o^t a(t)dt$$

$$y(t) = y_o + \int_o^t v_y(t)dt$$

$a_c = -\omega^2 r = -v^2/r$

- $F_{fr} = \mu F_N$
- $F = -\frac{dU}{dx}$
- $W = \int \vec{F} \cdot d\vec{s}$
- $P = \frac{dE}{dt} = \vec{F} \cdot \vec{v}$
- $F = -\frac{Gm_1 m_2}{r_{12}^2}$
- $U = -\frac{Gm_1 m_2}{r_{12}}$
- $G = 6.7 \times 10^{-11}\ Nm^2/kg^2$

Figure 1.

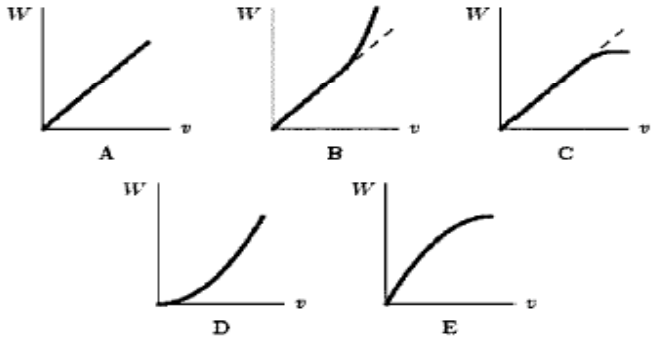


Figure 2.

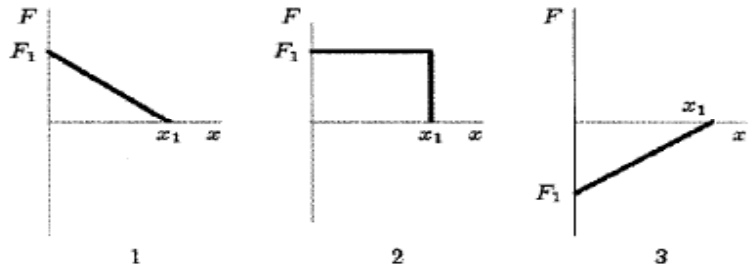


Figure 3.

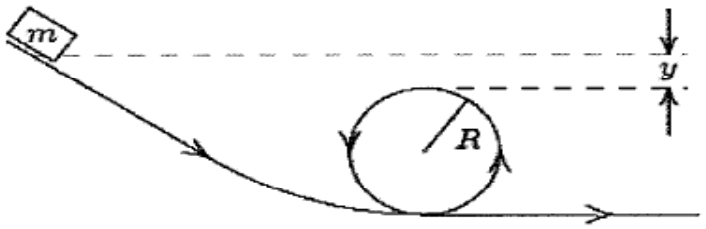
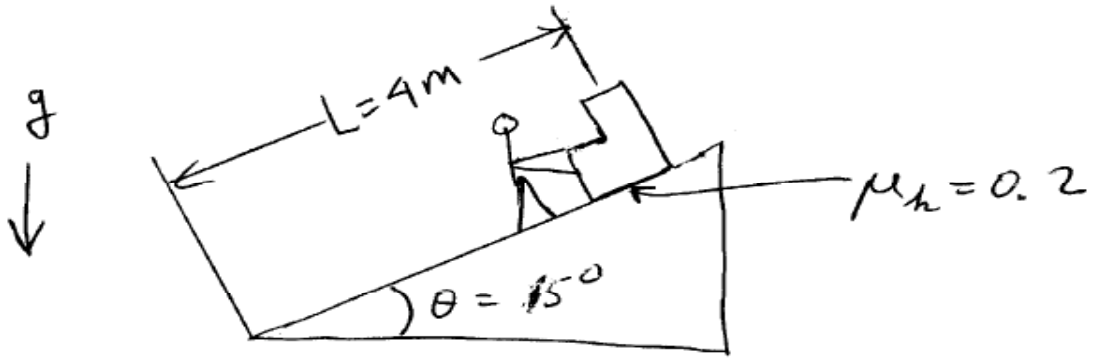


Figure 4.



Physics 4A Winter 2006 February 24, 2006
Professor C. M. Surko Quiz 3

Be sure to indicte your Code Number and the Test Form on the front of your Blue Book
The Test Form is indicated on the bottom of this page.

Please see preceeding page for potentially useful formulae. This exam contains 11 problems.

Problems 1 - 6, inclusive count 4 points each; and problems 7 - 11 count 8 points each.

Partial credit will be given for Problems 7 - 11, so please show your work clearly.

There will be no partial credit for problems 1 - 6.

Please put the answers to problems 1 - 6 on the first page inside your blue book.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Please note: If no answer is correct, choose the answer that is closest.

1) A baseball is hit high into the seats of a baseball stadium. Over its entire trajectory, the work done by gravity and air resistence are respectively
   A) positive, positive
   B) positive, negative
   C) negative, negative
   D) negative, positive
   E) not able to be determined with the information given

2) A man pushes a crate that weighs 80 N a distance L = 5.0 m in the direction along a frictionless plane that makes an angle of 30^{o} to the horizontal. The force that he exerts is parallel to the slope. If the speed of the crate is constant, the work that the man does is
   A) - 200 B) 61 C) 140 D) 200 E) 260

3) This problem refers to Figure 1 on the formula pages. A crate is initially at rest on a horizontal, frictionless table. A constant horizontal force, F, is applied. Which graph correctly plots the work W done by the force as a function of the speed, v, of the crate?
   A) graph A B) graph B C) graph C D) graph D E) graph E

4) An ideal spring with spring constant k = 80 N/m is oriented horizontally. One end of the spring is fixed, and the other end is attached to a 0.5 kg mass that oscillates horizontally as it moves on a frictionless surface. If the total mechanical energy of the spring-mass system is E = 0.12 J, the maximum speed of the mass (in m/s) is approximately
   A) 0.15 B) 0.24 C) 0.49 D) 0.69 E) 1.46

5) This problem relates to Figure 2 on the formula pages. The graphs show the magnitude of a conservative force on a particle that moves along the positive x axis from x = 0 to x = x_1. The force is parallel to the x axis. Rank the situations according to the change in potential energy associated with the force, from the least (or most negative) to the greatest.

A) 1, 2, 3 B) 3, 2, 1 C) 2, 1, 3 D) 3, 1, 2 E) 2, 3, 1

6) This problem relates to Figure 3 on the formula pages. A small object of mass m starts from rest and slides along a frictionless loop-the-loop track of radius R. What is the smallest value of y such that the object will slide around the loop without losing contact with the track?

A) R/4 B) R/2 C) R D) 2R E) zero

The following questions are not multiple choice. Please show your work in addition to the answer in your blue book.

7) A crate of mass m = 5 kg can move horizontally on a frictionless surface. If it is subject to a constant horizontal force F = 40 N and starts from rest at position x = 0, at what rate is the force doing work when the crate is at x = 2 m?

Situation I. This problem is illustrated in Figure 4 on the formula pages. A man moves a piano with a mass of 230 kg slowly down a ramp orientied at an angle of 15^o to the horizontal. He pushes against the piano, so that it slides without speeding up, moving it a total distance L = 4.0 m along the ramp. The coefficient of kinetic friction between the piano and the ramp is $\mu_k = 0.20$.

8) In Situation I, what is the sign and magnitude of the work done on the piano by gravity?

9) In Situation I, what is the sign and magnitude of the work done on the piano by friction?

10) In Situation I, what is the sign and magnitude of the work done on the piano by the man?

11) A satellite of mass m makes a circular orbit about the earth at a radius r. Find the total mechanical energy of the earth-satellite system, E_{tot}, assuming that the gravitational potental energy is zero at r = ∞. Express your answer in terms of tm, r, the gravitational constant G, and the mass of the earth, m_E.

Answer Key
Testname: GF 3 III

1) C
2) D
3) D
4) D
5) C
6) B
7) No Correct Answer Was Provided.
8) No Correct Answer Was Provided.
9) No Correct Answer Was Provided.
10) No Correct Answer Was Provided.
11) No Correct Answer Was Provided.